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ABSTRACT

This case study examined the ways a groupware tool, TWISTER (Talking - Writing - Information access - Solving problems with Technology for Education and Research), was used to create a learner-centered distance learning environment in a telecommunications in education class. Data were collected using learner participant surveys, observation field notes, interviews, computer transcripts, and course artifacts. Data analysis focused on participant use of TWISTER, characteristics of the participants and learning environment that influenced participation, and communication and interaction in the different components of the learning environment. Findings indicated that participants recognized limitations in interactivity frequency and levels in the compressed-video environment. Planned activities successful in this environment included using a wide range of activities and providing several means of access for communication. Although open and collaborative activities encouraged rapport building and enhanced interaction, participants still identified challenges. Use of TWISTER to facilitate student-centered activities also presented challenges. The tool did not support the activities as intended, and there was low overall usage. For participants, the added value of the groupware features did not outweigh the convenience of e-mail. Existing habits and limitations in functionality and interface were likely contributors to this low use. Results suggested that distance learning environments need to be improved through devising learner-centered activities and increasing interaction. Recommendations for practice are included. (Contains 56 references.) (MES)

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# A Case Study of Using Groupware to Support Collaborative Activities in a Distance Learning Course

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**Abstract**

*This case study examined the ways a groupware tool, TWISTER, was used to create a learner-centered distance learning environment. Data were collected using learner participant surveys, observation field notes, interviews, computer transcripts, and course artifacts. Data analysis focused on participant use of TWISTER, characteristics of the participants and learning environment that influenced participation, and the communication and interaction in the different components of the learning environment.*

*Findings indicated that participants recognized limitations in interactivity frequency and levels in the compressed-video environment. Planned activities successful in this environment included using a wide range of activities and providing several means of access for communication. Although open and collaborative activities encouraged rapport building and enhanced interaction, participants still identified challenges. Use of TWISTER to assist in facilitating the student-centered activities also presented challenges. The tool did not support the activities as intended. There was low overall usage of the tool by all participants. For the participants, the added value of the features afforded by groupware did not outweigh the convenience of email. Existing habits and limitations in functionality and interface were likely contributors to this low use.*

*Results suggested that distance learning environments continue to need to be improved through devising learner-centered activities and increasing interaction. Recommendations for practice included: 1) assessing and preparing the learners for the learning environment, 2) incorporating ongoing community building and other short activities, 3) planning extra time for management issues, training, and practice, and 4) selecting groupware tools based on functionality in a learning environment and the types of activities to be supported.*

## Introduction

Post-secondary institutions are rapidly adopting distance modes of educational delivery because of technological innovations, but more than the technology needs to be explored. The teaching and learning also needs to be examined (McIsaac & Gunawardena, 1996). All too often these new technologies are used to present one-way lectures to students in remote locations (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Contemporary perspectives in teaching and learning theory emphasize student-centered pedagogies where students take part in the development of their own learning experiences (Jonassen, Davidson, Collins, Campbell, & Haag, 1995; Savery & Duffy, 1995; Scardamalia & Bereiter, 1994; Spiro, Feltovich, Jacobson, & Coulson, 1991).

Interactions among students and instructors are a vital piece of student centered learning. Despite innovations in distance learning technologies, student-centered models of learning are difficult to implement in distance learning environments. The communication among participants and levels of interaction are still a concern. Problems lie not only in how the technologies are being used, but also there remains some limitations in the technologies themselves. For example, compressed video delivery systems have been touted as a premier interactive distance learning technology, however, studies show that interaction and communication is still hampered making the use of collaborative learning activities rare (Comeaux,1995; Harnish, Reeves, & Noah, 1996; Henri & Rigault, 1991; Kolomeychuk & Peltz, 1992; McHenry & Bozik,1995; Thomerson & Smith, 1996).

Today's technological developments can enhance communication among the participants of a course. Through computer mediated communication tools such as email and conferencing, it may be possible to create environments that do not require face-to-face meetings as the only means for achieving student-centered, collaborative learning models.

Groupware tools may be one such technology. Groupware "help[s] groups structure work through group decision support systems, project management tools, electronic conferencing systems, and shared editors" (Jonassen, Davidson, Collins, Campbell, & Haag, 1995, p. 17). This research sought to identify ways in which groupware tools could be used to support collaborative activities in a distance learning environment.

Groupware systems, in general, differ from other Internet conferencing tools like email/Listservs and newsgroups in several ways. Email/Listservs have little if any structure to the messaging. There may be several topics being discussed simultaneously. Messages of varying topics can be sent sequentially. This requires the user to create their own structure upon receipt. Listservs only exacerbate this problem with many having a heavy message load. Email/Listservs are referred to as "push" technologies because the information is sent to the user. Another of type is "pull" technology. Newsgroups are "pull" technology. With this form of conferencing the user goes to an

internet location where the conference is maintained. "Pull" technology solves some of the structuring and load problems. Newsgroups provide some threading of messages and users can select which messages they would like to read. (Dennis, Pootheri, & Natarajan, 1996).

Given the added functionality and support for group work that groupware provides, researchers hoped that student-centered models of learning might be applied to post-secondary learning environments where participants are separated by space and/or time. Based on a review of current perspectives in the areas of distance learning, open-ended learning, and collaborative learning, the following features were identified as important to selecting a groupware product.

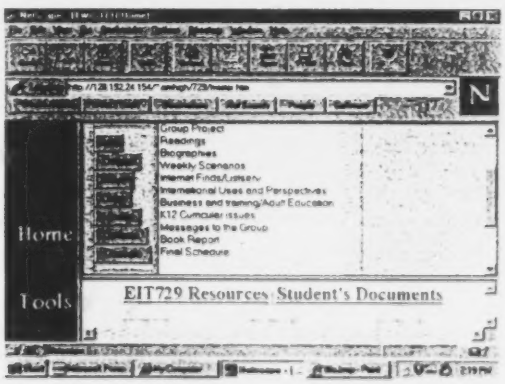
The WWW is a relatively accessible technology to participants affiliated with a higher education institution and was therefore considered exclusively as the delivery medium. The WWW also offers a familiar environment, thereby presenting only a slight learning curve to most participants. Past groupware systems were often proprietary systems run on, LANS or WANS. Recently, many Internet-based systems have been made available.

Other desired features of the groupware included:

1. A space for presenting an anchor or macrocontext can assist learners in an environment that enables open exploration into a set of concepts or set of skills (CGTV, 1992).
2. Participants should be able to engage in both synchronous and asynchronous communication. The added capabilities to thread discussions and link ideas can provide metacognitive support.
3. Databases of information provide resources for accessing content. These could include both pre-developed resources as well as those produced through participant's prior learning such as a case library.
4. By giving learners the ability to add or post group products they contribute to the knowledge base of a larger group and also see that their products have value. (Scardamalia & Bereiter 1994; Lebow, Wager, Marks, & Gilbert 1996).
5. Hypertext links will provide a means for practicing and learning cognitive flexibility. It also enables the idea linking described above (Spiro, Feltovich, Jacobson, & Coulson 1991).
6. Writing/production tools enable groups to produce evidence of their knowledge and expertise.
7. Metacognitive process structures can be built into the environment as a coaching mechanism until learners are comfortable directing their own learning.
8. Shared workspace allows collaboration among individuals as they strive to construct meaning of the concepts or practice skills. For example, this could be in the form of a synchronous whiteboard.

The web-based system used in this study was TCBWorks. This groupware product was designed to support writing, synchronous and asynchronous discussion, idea generation, and decision-making (Dennis, Pootheri, & Natarajan, 1997). Because it did not provide all of the desired features, TCBWorks was incorporated into a class web site that added some functionality. The web site, TWISTER, Talking - Writing - Information access - Solving problems with - Technology for - Education and Research (no longer available online.) integrated a variety of tools including TCBWorks, a groupware product, as well as simultaneous Internet access to information resources, course information, and other related resources. See Figure 1.

*Figure 1 TWISTER Tools*




**Methodology**

The aim of this study was to create and examine a student-centered distance learning environment facilitated by using a groupware tool as a supplement. Naturalistic data collection and analysis were used in order to gain an understanding of the participants' experience and to identify considerations for using a groupware tool to support a distance learning course. Given the nature of qualitative research, the questions with which I began this study were open enough to allow for a flexible research design and the possibility of unexpected outcomes. As the study progressed, the following questions guided my data analysis.



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Question 1: What factors (i.e. participants' personal characteristics, attitudes, skills, or circumstances) influence participation within the three learning environments (in-class, COMPRESSED VIDEO, and TWISTER)?

Question 2: In what ways do the participants (instructor, teaching assistant, and students) make use of the GROUPWARE tool?

Question 3: What is the communication and interaction among the participants like? Are there patterns of interaction that emerge in the different learning environments?

This study looked at the complex phenomena that occur in a distance learning course supplemented with computer supported collaborative learning activities. The participants' behavior in such a complex, dynamic situation is not as easily controlled as in a laboratory style study. In order to study the uniqueness and complexity of this situation, the whole phenomena was investigated in an authentic environment (Jordan, 1996; Lecompte & Preissle, 1993; Patton, 1990). Through qualitative case study, a deep understanding of the context, the participants, and the interactions among them emerged.

This research study examined a telecommunications in education course offered spring 1997. This course met for a ten-week term at two different sites simultaneously with each classroom connected via compressed video technology. In addition, other class activities took place both synchronously and asynchronously through a groupware tool, TWISTER. This format falls under what Harasim, Hiltz, Teles, and Turoff (1995) call mixed mode, in which the class meetings are extended and supported by computer mediated activities and discussions.

During the first two weeks, data were collected to provide a baseline profile of the students, instructor, and class environment through student pre-surveys, an interview with the instructor, and in-class observations. Throughout the quarter the instructor, teaching assistant and researcher held weekly debriefing sessions. During each class session the research captured written field notes from alternating sites. In the last two weeks of the course, student participants were interviewed individually and in their collaborative work groups. Finally, a post-survey was given to the students. Both the instructor and teaching assistant were interviewed at the conclusion of the course. All of the instruments were developed specifically for the study. The tasks used in the class projects were co-developed by the researcher, the instructor, and teaching assistant.

There was a wide range of activities planned for this class. There were individual and collaborative, technology supported and technology required, in-class, and independent. These activities also included a variety of different kinds of tasks including idea generation, problem solving, construction/production, and hands-on. These varying activities were built in to meet the needs of different learners with varying skill levels. Also, for research purposes, the wide variety offered an opportunity to examine a breadth of activities both supported and not supported with compressed video and TWISTER.

During a class session it was typical for participants to engage in a discussion of the readings led by fellow students, one from each site. This might be followed by a guest lecturer or a presentation from one member of the instructional team. Time would then be provided for each of three small collaborative groups to meet over the system to work on a web development project. Finally a technology product or skill might be demonstrated with a lab activity to follow.

Outside of class students were expected to interact on TWISTER at least weekly. Weekly TWISTER activities included readings discussions, posting internet finds, and responding to weekly scenarios developed by the instructional team. It was envisioned that TWISTER would also serve to support the collaborative groups developing a topical web-page. Several individual written activities were also required assignments.

**Data Analysis**

The primary goal of a case study is to look deeply into the complexities of a single phenomenon or instance. The analysis process was formative as were some details of the overall research procedures. Initially, the data were approached openly with only the initial research questions in mind. Following one open coding review, the data were searched categorically in the NUD*IST database. Using the reports generated with these searches, profiles of participants, the learning environment, and the communication and interaction among participants were developed. Finally, assertions from these profiles were categorized and validated and synthesized using relevant literature.

Initially, transcribed data, along with the computer transcripts, were uploaded into NUD*IST software to assist in data management and thematic searching. It also served as a verification for more consistent coding of the participants' own words than what coding by hand might have produced.

Profiles of each participant were developed including both students and the instructional team. Member checking was also done with student participant profiles by emailing each student participant a draft of their own profile and requesting comments.

Using research questions 1 and 2 as guides, data sources were reviewed to develop a profile of the learning environment including utilization of TWISTER. Results comprised of data from across all data sources were sorted

according to one of the following aspects of the learning environment: course structure and design, course activity, physical facilities, technology implementation and technology utilization by both students and the instructional team.

The last review of the data examined the communication and interaction among the participants in the course. Again, reports were generated using keyword searches in the NUD*IST database. These reports were most useful in understanding student and instructional team perceptions of interaction and communication in each of the three learning environments: face-to-face, compressed video, and TWISTER. Additionally, the TWISTER transcripts were examined closely to examine participation, types of communication, and levels of interaction of individual students for both the planned and unplanned online activities. Using data summaries of each small collaborative group project, cross case comparisons were also completed.

**Validity**

All of the data collected came from the participants. This approach lends itself to an emic data analysis process. As data were analyzed, interpreted, and prepared for presentation, I made a rigorous effort to include the participant's own words (Patton, 1990). Although I am a participant, I am also a researcher; in some instances and for some research questions, I relied on my own typologies or categories in order to interpret the data. In these instances I have used what Patton (1990) calls an "analyst-constructed" or etic approach to data analysis.

Because I was involved in the research as both a researcher and a participant, it was impossible to completely separate my own interpretations from the reality of each of the participants. In order to guard against my own interpretations dominating, planned member checking, triangulation, and reminders to myself of my own worldview and potential biases were integrated into the analysis plan. Finally, all assertions are discussed in comparison to relevant literature.

**Reflection on the Methodology**

This methodology offered a unique and in-depth understanding of one class' experience using a groupware tool to support course activities. What makes this study unique is that the perspectives of all the participants were studied in-depth. Gaining the learner's perspective not only informed the researcher's understanding of this case, but also offered learners the opportunity for reflection on all aspects of the course. This study attempted to contribute to the body of knowledge in instructional technology by identifying the issues involved in studying distance learning and groupware environments (Koschmann, 1995; McIsaac & Gunawardena, 1996).

Nonetheless, there were clearly limitations that have been illuminated in retrospect. The most dominating limitation was the relationship between the instructor and the researcher. The instructor and researcher were involved in the design of the course and the design of the research. Each having a hand in both presented several problems. These problems emerged during data collection, data analysis, research design, and course implementation. Both learners' experiences and the instructional team members' experiences were affected.

First, the instructor of the course was required to wear "multiple hats." She was continuously asked to be conscious of her roles as research adviser and course instructor. This consciousness of dual roles by the instructional team impacted data collection.

There was hesitancy among instructional team members to discuss particular students, more so in a potentially negative light, and have it captured on tape. For example, members of the instructional team would ask for the tape to be turned off, if the conversation was moving in that direction. Therefore, these discussions were not captured and raw data was sometimes lost. As a result some potential findings could not be substantiated. The findings, primarily regarding the challenges that emerged in the course, surrounded issues of instructional design and technology implementation. This captured only two parts of the picture. A third part was the participants' responsibility for meeting expectations in the course and making use of the available tools. Although the study was designed to capture learner characteristics that might influence participation and communication, this failed for two reasons. First, the data collection instruments gave the learners an opportunity to describe challenges they faced in the class, but did not ask them to reflect on what their role may have been. Second, follow-up data collection opportunities were not planned to gain participants' reflections after this issue was discovered late in the data analysis phase. Moreover, it was the tendency of the instructional team to take responsibility for problems as issues of instructional design and limitations of the technology. This is what was captured in the data and thus presented as findings.

Because of these "multiple hats" learner perceptions were also affected. Data suggested that the instructor also carrying a research adviser role caused some mistrust between learners and the instructor. Moreover, learners perceived the researcher as closely and personally tied to the groupware. There was some concern as to how that might have impacted the data and findings.

Research also had an impact on the selection of a groupware product. In order to collect transcripts of the online discussions, the product had to maintain a record of the communication. TCBWorks offered the opportunity

to customize the usage privileges of participants. For this study users were not able to delete, move, or modify the transcripts. Several users found this lack of capabilities to be frustrating.

Finally, this feeling of mistrust was evident during data collection. The researcher sensed during individual interviews that students were not completely honest regarding their experience in the course. This was confirmed for one participant. In most of the data, she described an overall positive experience in the course, however on her post-survey she revealed somewhat negative attitudes and experiences.

These limitations served as a filter for presenting and validating the conclusions and recommendations asserted in the next sections. Despite the recognized difficulties, important outcomes emerged.

**Discussion of the Findings**

As Stake (1995) suggests, meaning is added to data after breaking apart the instance and putting it back together. Data were reviewed three times from the frame of each research question. After completing these three in depth reviews, synthesis occurred by examining the findings from the original purpose of the research. Findings were sorted according to the broad categories: the compressed video environment, achieving a student-centered distance learning environment, and integrating the groupware tool. Stepping back to this broader frame enabled a threading of the findings for representation and discussion. Conclusions were validated using relevant literature.

***Teaching and Learning in a Compressed Video Environment***

Learner participants in this case described being inhibited in interacting over the compressed video system with some feeling as though they were "interrupting" in order to participate. Students also noted difficulties in getting others to interact with them. One participant described her experience leading a discussion as "pulling teeth" to get others to participate. Another equated her experience with receiving the instruction over compressed video when the instructor was not at her site to "watching TV" making it difficult to pay attention for longer than 15 minutes at a time. Several participants observed that the subtleties of face-to-face communication, i.e. body language, facial expressions, no delayed responses, were lost when communicating over the compressed video system. The instructor also observed the student-student interactions as being low level. She considered class readings discussions to be "boring" and in comparing a face-to-face class meeting to one over the compressed video system, she refers to the discussions during the face-to-face "like a real class." Mediated communication through compressed video impacted the interactivity among students as well as the interaction between the students and instructor. Similar accounts of these types of challenges were reported in much of the recent distance learning research on communication in compressed video environments (Comeaux, 1995; Fulford & Zhang, 1994; Kearsley, 1995; McHenry & Bozik, 1995; McHenry & Bozik, 1997; McIsaac & Gunawardena, 1996; Repman & Logan; 1996; Schrum, 1996; Tiene, 1997; Wolcott, 1996).

The interaction between students and the instructor took many forms as suggested by Garrison and Shale (1990). There were the expected challenges for the instructor with presenting information and providing feedback to the learners. Additionally, extra time was needed for redesigning the activities and presentation of information took time to redesign for this environment. Providing feedback to students required coordination to get the right assignments to the right location on the same day. In some instances the feedback was provided via supplemental technologies like fax, phone, or email. The facilitation of these types of responsibilities was distributed between all members of the instructional team. One issue students commented on as being problematic, however, was that the professor was only available every other week for face-to-face communication during class. The attitude and expectations of students as well as their physical location were key here. Students at the local site were less likely to be accommodating to a physically distant instructor than were the remote site students. Since the remote site students were all aware that the course was being delivered over compressed video and because they gained the conveniences afforded through receiving the distance delivery, interacting with the instructor every other week was perceived positively. For students at the local site, however, it was perceived less positively. Prior to the first night of class, many of the local site students did not realize the course was to be delivered at a distance. Several commented that it was enough to "put up" with the videoconference technology, but to have also lost access to the instructor without the added conveniences, was frustrating. Students from both sites agreed that the supplemental technologies did not provide the immediate, two-way interaction sometimes necessary.

"Clarity" in communication also emerged as a major issue in this class with several students. For example, there was a request for clarification of the assignments on almost a weekly basis. This information was provided in the syllabus and discussed during class, yet there was still confusion among some participants. Other instances of a lack of clarity included students not being prepared for class because they "didn't know" or did not remember information disseminated during a class session.

Many of the above challenges have to do with what researchers have referred to as psychological distance (Comeaux, 1995; Wolcott, 1994). Being aware of this from the accounts described in the literature, the instructional team designed the course to incorporate instructional strategies, techniques, and activities that would minimize the psychological distance therefore creating a more student-centered environment.

***Designing Student-centered Instructional Strategies for Distance Learning Environments***

Using a wide variety of activities in-class and for individual assignments was an attempt to cater to varying knowledge and skill levels, learning styles, and location, and to make the most of the technologies employed. As suggested in the literature most worked well in the environment. Rapport building strategies included icebreakers, being available before and after class, and building in time for questions. Interaction enhancing strategies included using a variety of activities beside lecture, encouraging participation from each site, and making a multitude of ways available to access other participants (Schrum, 1996; Wolcott, 1996). The following two strategies yielded rich findings and were explored in more detail: open learning activities and collaborative activities.

The instructor had always used open learning activities in her course in order to provide learners with an opportunity to make the learning authentic and meaningful for themselves. In reflection, the instructor admitted that there are always some students who become uncomfortable with defining their own learning goals. Often students have no experience defining their goals and negotiating them with an instructor. Similarly, in this case there were some students who were uncomfortable with this process. Eventually all students except one found these open-ended assignments to be personally meaningful. Given these results, this strategy proved successful for this case.

Collaborative activities were used as a means of community building to bridge the psychological distance and increase interaction. Collaborative learning strategies provide opportunities for learners to build knowledge though discourse by solving a problem or completing a task in a group (Blumenfeld, Marx, Soloway, & Grajcik, 1996; Joyce & Weil, 1992). Although collaborative learning activities are known to be difficult to implement in distance learning environments because of the geographic and temporal separation of the learners, if carefully designed they are possible (Henri & Rigault, 1991). In this case there were several opportunities designed for learners to collaborate in small groups and dyads across sites. Findings specifically related to collaborative activities supported by TWISTER are presented in the next section.

Using characterizations of collaborative work from the literature, the small group projects were more successful in providing students the opportunity to work closely with others and learn by completing a task (Barnes & Todd, 1995, Blumenfeld, Marx, Soloway, & Grajcik, 1996; Crook, 1994, McReary, 1990; Sharples, 1993; Webb, 1992). As seen in the Readings Dyads little, if any, collaboration in preparing the readings occurred for most of the dyads.

Two of the three groups experienced problem behaviors as identified by researchers in collaborative learning (Blumenfeld, Marx, Soloway, & Grajcik, 1996; Johnson & Johnson, 1992). One group experienced problems with accountability. A sole member participating in the class from the remote site did not play a significant role in her group's final product. In another group, there was a rich-get-richer-effect. Because one participant had web development experience, she took over the responsibility for this and neither of the other two participants gained skills in this area as a result of the activity, yet she gained more experience. As seen in both these identified collaboration problems there was a link between the participant with the problem behavior and their physical location. The participant with web development expertise did not share her web development skills with the other members of her group because they were not physically accessible during the times she did the development. The participant accused of low participation was a self-described introvert and low level technical skill holder. She claimed she had difficulty contributing to her group especially since she was the only member at the remote site. This physical separation of one learner from the other two impacted the cohesion of these two groups. The small number of participants in the cross-site group was a likely factor as well.

***Incorporating a CSCL Tool in a Distance Learning Environment***

In order to facilitate many of these student-centered strategies, TWISTER was devised as an extension of the learning environment. Findings regarding its implementation, use, and support for the activities follow.

The instructional team envisioned and designed the learning environment to include use of TWISTER to support a range of instructional strategies. Although referred to as a supplement and never used solely as a means to support an instructional activity, the team planned for TWISTER to be an integral part of the course. Despite this intention, neither the instructor nor the students used it in this way. Difficulties encountered with the features and functionality of TWISTER proved to limit the mode of implementation to a less integral mode, i.e. what Harasim (1996) would refer to as adjunct. Most participants found little value in the added features of having an integrated course support tool. The value did not outweigh the challenges they identified with the features and functionality.

The design of TWISTER was based on findings from the literature and pilot studies with an earlier prototype (Ahern, 1993; CGTV, 1992; Guzdial, Turns, Rappin, & Carlson, 1995; Kaplan & Carol, 1995; Lajoie, 1993; Lebow, Wager, Marks, & Gilbert, 1996; Scardamalia & Bereiter, 1994; Schrum, Fitzgerald, & Luetkehans, 1997; Suthers & Weiner, 1995; Wan & Johnson, 1994). Desired features of the tool included space to post information or orienting scenarios, asynchronous and synchronous capabilities, support for threaded discussions, hypertext capabilities, information searching capabilities, scaffolding for metacognitive process structures, and the capability for participants to produce, share, and display products. In this case, the prototype tool, TWISTER, did

not incorporate scaffolding or production tools. Moreover, as discussed in the following section the synchronous capabilities had limitations in functionality impacting use in this class.

Synchronous/Asynchronous. Considerations Schrum (in press) suggests for when to choose synchronous tools include number of participants, skills of learners, and the type of task. Although, there was only one trial of a synchronous session by the participants, that one instance demonstrated TWISTER's weak synchronous conferencing capabilities. Learners in one of the small work groups were disappointed by time lags and access problems during their attempt.

In this study, several types of tasks were designed to examine how the different capabilities of each learning environment support the varying needs. Types of tasks built in were brainstorming and idea generation (Scenarios), information sharing (Internet Finds), dyadic negotiations (Readings discussions), and small group projects which incorporated a range of tasks including brainstorming, problem solving, and construction/production. Harasim (1993) also recommends task type as an important consideration for choosing synchronous versus asynchronous conferencing tools.

Since there was such little use of TWISTER it would be unfounded for this researcher to make any inferences for best uses of a groupware tool with synchronous and asynchronous conferencing. However, a comparison of observations of the asynchronous use of TWISTER with the synchronous use of compressed video for groups to come to a consensus indicated that decision-making was difficult in asynchronous online environments. Instead of breaking tasks to the level of specificity described above, Harasim (1993) looked at tasks as being convergent and divergent. As seen in the small work groups, compressed video (synchronous) provided a better environment for some types of tasks. When the groups described their group process, all of them stated that compressed video was the better means for decision-making, a convergent activity. Data were also consistent with Harasim's (1993) findings that asynchronous tools are better for divergent activities, e.g. brainstorming, discussion, information sharing.

Hypertext/threaded discussions. Two students recognized the value of being able to structure and organize a conference, i.e. a threaded discussion. Although these two students attempted to do so using the hierarchical structure, other participants made little use of the organizing capabilities. Data showed that there was little interaction reaching the level of a dialogue suggesting that learners did not have a need to impose an organizational structure on their postings.

Space for macrocontext. The hierarchical structure of TCBWorks worked well in serving as a place to present orienting scenarios. The weekly scenarios proved to be the favored use of TWISTER by both the learners and instructional team. With each weekly scenario given a dedicated space, learners could post responses and follow the threaded postings. Although the responses to the weekly scenarios never reached the level of a dialogue, students had no complaints or problems using the tool for scenarios.

Other features not utilized by participants. Two other features available to users of TWISTER were information searching and voting. The information searching feature allowed participants to search the world wide web while communicating in TWISTER. Although this feature was introduced and recommended to learners and identified as a need by at least one small work group, the feature was never employed. Participants claimed they did not realize it was available. The second feature not used by participants was the voting feature built into TCBWorks, the groupware product. This function was not particularly intuitive, and it was likely participants would have needed training. The voting feature was there to assist groups of users in coming to consensus. Although there was an expressed need for support in decision-making by the small groups, the voting feature did not appear to translate well to a learning situation. The instructional team mentioned voting as an available feature when TWISTER was introduced, but they did not encourage its use nor provide specific training.

***Learner-interface Interaction***

Hillman, Willis and Gunawardena (1994) suggest an additional type of interaction experienced in distance learning environments, learner-interface interaction. This type of interaction refers to the "transparency" of the technology. TWISTER was a prototype groupware tool, and although it was tested, was still laden with design and functionality difficulties. Data suggested that these peculiarities kept the tool from becoming transparent for these learners.

TWISTER's limitations in functionality presented challenges to learners interacting with the tool. Additionally, learners perceived as an inconvenience having to "go to it" in order to interact. Conferencing systems like TWISTER are often referred to as pull technologies (Dennis, Pootheri, & Natarajan, 1997). Email can be described as a push technology, the opposite of a pull technology. With push technologies like email and Listservs, conferencing information and messages are sent to participants' email box. If they are regular email users, as many were in this class, checking email was already a familiar and often daily activity. Knowing this, learners and instructors often opted for email when they wanted to be sure the information would be received or if they wanted to initiate a two-way dialogue.

*Learner Characteristics*

Consistent with studies examining online learning environments, data in this case indicated that participant characteristics proved to be indicators for how and when they used the groupware tool (Eastmond, 1995; Hiltz, 1990; Schrum, 1996). Characteristics emerging as important included: access, experience and skill level, and attitude. The type and means of access a student had to the internet outside of class time affected their use of the groupware tool. Access was a factor deemed important at the outset of the research, however, the full extent of its impact was underestimated. Not only did learners with unreliable or no access, struggle, but learners with limited access also encountered difficulties. Learners with home or work access, only, were sometimes limited in the days or time of day they could interact on the system. Furthermore, those with limited, unreliable or no access also affected the work of others trying to collaborate with them.

Previous experience and technology skill level were important indicators, too. This was seen from both ends of the continuum including low skills to very high skills and previous experiences, both positive and negative. Several studies have identified similar characteristics of readiness for participating in online environments (Eastmond, 1995; Hollingshead, McGrath, & O'Connor, 1993). In order to expect learners to participate, a minimal skill level was required from the outset. Again, in collaborative environments, one learner's struggle can impact a whole group or even class. But still, some students bring with them notions and habits with which they are accustomed. This, too, can affect their participation.

Finally, attitudes toward several aspects of the learning situation were apparent indicators for participation and utilization. Consistent with what O'Malley and Scanlon (1990) found, despite learners' range of attitudes toward group work, most described their experience with the groupwork in this course as positive. Findings from this case differ from O'Malley and Scanlon (1990) however, with the small work groups. Some learners expressed negative opinions about having participated in cross-site collaborative groups and most learners agreed the groupware tool did not support their small group's work well.

This study examined two types of interaction using the groupware tool: learner-learner interaction and learner-instructor interaction. Participants in this class used the tool to share ideas and information and to maintain records. There was little demonstration of interaction reaching beyond the level of individuals posting single messages or pieces of information to the large group. This finding followed a one-to-many pattern of interaction proposed by Romiszowski and Mason (1996) as common to asynchronous tools. Data suggested that utilization of groupware tools is a complex and multifaceted issue. The limited use in this case was the result of problems learners had with system implementation, system access, as well as the features and the functionality of TWISTER.

**Recommendations for Practice**

These recommendations for practice result from a process of naturalistic generalization. Through careful data analysis, interpretation, and audit trailing, the findings from this case study were examined in light of the related literature. Caution was taken given the number of limitations in this study.

Assess the participants. This case demonstrated the impact that learner knowledge, skills, experience, and attitude can have on the learning environment. Before a new course begins it would be helpful to gain a sense of these characteristics for the particular set of learners in the learning situation. If there are wide ranges in skills and experience, activities can be tailored to meet individual needs.

Learners need to be prepared. Learner "readiness" as Eastmond (1995) suggested is important to successful implementation. First, learners need to understand how the course will be delivered. Additionally, in online or groupware environments they will want to be sure they have sufficient access to equipment.

The instructor should be prepared for the time it takes to manage a DL course. In this instance there were three members on the instructional team, and in every class meeting each member of the team was occupied with responsibilities. It is important that an instructor not underestimate the amount of time required.

Employ short and varied activities during class sessions. As one participant described, her attention span averaged about15 minutes when viewing instruction over the compressed video system. To expect learners to be able to pay attention for longer periods of time is unreasonable. Not only should activities be short, but also varied. By changing the type of activity, learners may find more opportunities to participate.

Constant clarification may be necessary. Given that the average attention span in compressed video environments may be only 15 minutes long, it can be expected that the learners may miss some information. Plan for this by reviewing often, or providing supplemental handouts.

Interaction does not come easily in DL Environments. Despite the difficulties, low levels of interaction need not be settled for. Interaction can be constantly encouraged by incorporating participatory, discussion-based activities, leaving little room for lecture. High levels of interaction may need to be modeled.

Build community. As the instructor in this case believed, building community is important in DL environments. However, rotating locations every week may not be the solution. Off campus learners registered for the course with the knowledge there would be differences; on campus students did not. These expectations can color learner attitudes and influence the dynamics of the class. Instead the instructor can make themselves readily

accessible in other ways. For off campus students, instructors might consider taking the initiative to check in with them outside of class sessions through supplemental media, e.g. email, telephone, etc.

Open and collaborative activities are important. Open and collaborative activities are important in building student-centered DL environments. Open activities give learners the opportunity to experience authentic and meaningful learning. Cross-site collaboration helps to build community and increase interaction. Consideration, however, should be given to the group size and location of participants. Consider using an equal number of learners at each site. If groups are constructed based on particular characteristics, e.g., expertise, locations of these individuals should be noted. Also consideration should be given to providing supplemental technologies as necessary. A groupware tool may not be the only solution; email, synchronous chat tools, telephone, and fax could also be considered.

Allow sufficient training and time for learning groupware software. In presenting learners with a new software tool, ample training and guidance needs to be provided. Becoming adept at using the groupware tool could take longer than ten weeks. For most people, groupware would be a new class of software. This learning curve coupled with learning the content of the course may require additional time as well as practice before participants become proficient at using it.

Consider the Best Uses of Tool Features for Specific Task Types. In deciding whether to use a synchronous or asynchronous tool one should consider whether the activity is convergent or divergent as Harasim (1995) and Danielsen (1994) recommend and findings in this study concur. Consideration should also be given to whether the tool is a "push" or "pull" technology. Based on usage in this case, push technologies like email ought to be considered for addressing an individual or a one-to-one dialogue. Pull technologies, on the other hand, appear to work well for larger groups and maintaining a group record.

Selecting a groupware tool. Selection criteria needs to begin with whether the tool will translate well to a learning environment. As in this case, adapting a tool originally developed for business work groups posed some challenges. These challenges emerged because the tool itself had to be adapted to fit the intended uses and not all the features were usable. Also, the tool selected has to be fully functional. Using a prototype became an issue for this group. "Quirks" and "kinks" were eventually accommodated, but neither easily nor without frustration. The interface is also crucial. Learners should not be expected to conform to the tool. Again eliminating frustration and difficulties up front can help build a positive attitude in users. Finally, the value added versus required effort in selecting a tool needs to be carefully weighed. In this case, there was too little gained as a result of exerting a lot of effort to use TWISTER.

**Recommendations for Further Study**

Future studies considering similar overall questions to those in this study would be remiss not to be certain that the groupware tool employed is fully functional and meets the criteria described previously in the Recommendations for Practice section. The tool should be designed to support learning environments. Hopefully, it will be possible to employ a tool that incorporated fully functional features as described in the proposed model. Additional features would include scaffolding for instructional strategies and metacognitive processes, and shared production tools.

Also, more case studies similar to this would be useful for cross-case comparisons. Similar studies might also explore content areas outside of instructional technology without the methodological limitations described in the Reflection on the Methodology section.

Examining ways to improve distance learning environments continues to be an important line of inquiry. New technologies and new pedagogies have not bridged the "psychological distance" when participants are separated by space and time. Further questions to push this research area should consider such issues as:

- What are minimum, necessary, or desired levels of interaction?
- What can be done about this issue of "clarity" and missed information in DL environments?
- What are best practices for employing push versus pull technologies and synchronous versus asynchronous tools?
- What types of tasks can be supported by the various technologies?

**Summary**

In this case, a great deal was learned about using a groupware tool to supplement a distance learning course delivered over a compressed video system. Despite the careful design and crafting of a student-centered distance learning environment, participants identified a wide range of challenges. Instructors and students recognized limitations in interactivity frequency and levels, some activities did not work as intended and others were compromised by the environment or participants themselves. The open and collaborative activities encouraged rapport building and enhanced interaction. Nonetheless, challenges remained.

Use of TWISTER to assist in facilitating the student-centered activities also presented challenges. The tool did not support the activities as intended. Given the range of activities, the low usage of the groupware was



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surprising. Factors that influenced participation included participant characteristics and the learner-interface interaction with the tool. A lack of a compelling need may have existed, even though activities were built around TWISTER use. As for the small groups, it was evident that email, despite its lack of structure, was the preferred online communication medium. For the learners, the added value of the features afforded by groupware did not outweigh the convenience of a push technology like email. There was data to suggest that asynchronous communication better supported divergent tasks while synchronous tools supported convergent tasks.

Based on these findings, it appears that distance learning environments continue to need to be improved through devising learner-centered activities and increasing interaction. This can be accomplished by first assessing and preparing the learners for the learning environment. Additionally, instructional strategies should include short and community building activities. Finally extra time should be planned for management issues.

Incorporating a groupware tool will require extra time for training and practice. Tool design or selection considerations should include assessing the tool's functionality in a learning environment and the types of activities to be supported with the tool.

This case exemplified many of the potential challenges that can emerge in distance and online learning environments. As internet communication technologies mature, perhaps more viable groupware tools will become available and participants will become increasingly comfortable working in such environments. These factors may eliminate many of the difficulties encountered in this case. Meanwhile, in-depth case studies such as this are valuable in investigating the possibilities of the present.

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